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Green line strategy in mitigating climate change: case study in Tarakan City, North Kalimantan

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Abstract

Green belt is one of efforts in reducing urban air pollution level by planting trees along the road to absorbing pollutants. The purposes of this study are: (1) to know the Willingness to Pay (WTP) to reduce air pollution in Tarakan city, (2) to identify the factors that affect WTP. Locations of residential yard plantings are located on the roadside at the content exceeding the Threshold Limit Value. WTP method was used in calculating the community's willingness to pay for the planting of vegetation absorbs pollutant. The result of this research is that people are willing to pay (WTP) for IDR.7.325.98. The new prices are obtained by WTP is smaller than the current price set. And from the results of field's collected data there is only one variable that significantly affects the WTP of respondents, is the treatment cost

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Keywords: CVM; Green Belt; Pollutant; Vegetation, WTP

1. Introduction

Physical development of the city and establishment of industry center accompanied by the surge of motor vehicle production cause the increase of traffic density and of vehicle's side production, which produce one of air pollution (Soedomo, 2001). Air pollution resulted from motor vehicle emission will degrade the quality of air and endanger health of human being.

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Agglomeration causes an increase in travel costs and production costs (Scott in Kuncoro, 2004). Urban air quality is extremely decreased due to the high level of transportation activities. Motor vehicles' emissions such as gasoline (premium) or diesel fuel produce CO (Carbon Monoxide), NO2 (nitrogen dioxide), SO2 (sulfur dioxide), CO2 (Carbon Dioxide), Particle Pb (Lead), and photochemical smog, all of which can harm the health (Wardhana, 2004). Because of causing emissions, the rate of motor vehicle usage becomes significant upon a level of air pollution. If the contaminants stayed in the atmosphere for several times, it will be mixed with the rest of the atmosphere due to the effect of the global meteorological process. This can lead to a reduction in the ozone layer and to the greenhouse effect (Tjasyono, 2004).

If this is the case, then we need to find a way to reduce air pollution. For this case it is caused by lead (Pb). One of the efforts to reduce air pollution is through planting vegetation by the manufacture of the green line. Green line can be performed by planting the absorbing pollutant trees along the way that are useful to reduce the pollutants containing the city air. Types of shade trees that affect the up taking of lead content are *Filicium Decipiens, Pterocarpus Indicus, Caesalpinia Pulcherrima, Terminalia Catappa, and Acacia Auriculiformis* (Hendrianty, 2003).

The average growth of vehicle per year from 2004-2011 amounted to 9.87% (BPS, 2014). Furthermore, the length road in Tarakan is not increased significantly. This will cause congestion on major roads and the concentration of pollutants in congested areas. Environmental Management Agency (Badan Pengelolaan Lingkungan Hidup/BPLH) in Tarakan City has conducted a movement of reforestation. This movement is started from environment of Tarakan local government, i.e. Government Office Building in General Sudirman Street. At behind of this office building, BPLH have conducted cultivation of tree, flower and decorated the surrounding of the building environment with some banner and name-board to remind the society to love environment. Participation in controlling air pollution is also conducted by private party. PT Inhutani (Forestry Ltd) dispensed some tree seeds through Tarakan local government.

Air pollution effect of motor vehicle emission represents one of external expense that the responsibility should be taken by perpetrators, those who contribute more in producing air pollution. In fact, the external expense is not directly charged upon the perpetrators. Thus the external expense have to be assessed in some amount of money, so the external expense can be directly charged upon the perpetrators and the obtained fund can be used to increase the air quality.

Contingent valuation method is used to calculate the environmental cost, which is not included in market prices. The researcher uses willingness to pay method, which is one of types in contingent valuation methods. WTP is done by asking people some questions through questionnaires about how much compensation they need to protect the environment from air pollution caused by vehicle emissions, or "how much they want to pay to prevent this circumstance" (Button, 1996).

The offer of Willingness-To-Pay or of willingness-to accept obtained through a form of questioner survey and a form of elicitation (acquirement), with which people are asked to specify the maximum of their willingness-to-pay for environmental services, or compensation minimum of their willingness-to-accept for environmental services (Willis and Garrod, 1999).

1.1 Issue

1. What is the society's WTP value from their participation in reducing air pollution (Lead/Pb) by planting vegetation in Tarakan City?
2. Which are variables that significantly affect the value of WTP society participation in reducing air pollution (Lead/Pb) by planting vegetation in Tarakan City?

1.2 Literature review

Monetary valuation toward natural resources-based-trees is expressed by Tejo (2003) in his research of urban forest in Gadjah Mada University and by Campbell (1993) suggested in Zimbabwe. Both researches used contingency valuation method (CVM) to see the value of trees as a natural resource inventory. Samudro (2004) examined the impact of air pollution for public health in Sleman Regency. His research took data from patients of Sardjito Hospital suffered from diseases caused by CO, with code J.45 medical record. The result of this research is the increase of public expenditure due to the rising level of CO in the air.

Vassanadumrongdee and Matsuoka (2005) in Bangkok, state that WTP in order to reduce the risk of air pollution is influenced by the degree of anxiety, the size of NAB, and individual assessment, while the WTP in order to reduce the risk of traffic accidents is affected by direct events perceived by the respondents. Average value of WTP for air pollution amounted to $ 1.32 million and the average value of WTP traffic accidents amounted to $ 1.48. Vice versa, with Xie, Kontoleon, Zhang, and Yu (2011), they used the public payment and private payment approach. WTP values of public payment were greater 50% than the private WTP.

The impact of air pollution for health, Gravitiani (2003) and Mohajan (2012) state that the value of society's WTP is high. The only research that shows different result of society's WTP is conducted by Navrud (2001). The research is conducted in Norway, which shows that its society's WTP is the smallest among other European countries. This is because respiratory disease (ARD) is rarely found in this country. Although Gravitiani mentions the WTP value in Yogyakarta city is high, she spatially states that overcrowding does not fully affect the amount of PM_{10} and that of Lead of the air of Yogyakarta.

2. Methods

Population of this research was inhabitants residing in a side street, which closes to or exceeds the pollutant content of the NAB, and its willingness to plant trees. This study was conducted in seven (7) locations across the District on Tarakan City, ie Mulawarman Street, General Sudirman Street, Juwata Permai Street, Kusuma Street, Bhayangkara Street, Gadjah Mada Street and Lingkas Ujung Street. Random Technics was enforced to the respondents based on their acceptance or refusal to cooperate in this research. To determine the range of the population sample the researcher used Slovin formula (Hussein, 2004), namely: $n = N / (1 + Ne^2)$. Where, n is sample measurement; N is population measurement; e is critical value.

Table 1. Sample Range

		District Area	Total Population (Person)	Sample (Person)
Respondent	1	East Tarakan	45.398	45
	2	West Tarakan	71.572	71
	3	North Tarakan	23.284	25
	4	Middle Tarakan	64.028	63
		Total	204.281	204

Source : Data Processing, 2014.

The collected data is primary data collected from questioners directly answered by respondents. The questioners was composed using elicitation open-ended question method, in which there is no decided point, the respondents were asked a question of their maximum willingness-to-pay. The analytical method used to determine the community participation was the contingent valuation method (CVM), by using the approach of willingness to pay (WTP). The ordinary least square method was used to determine the influencing factors.

3. Result and Discussions

3.1. Analyze The Community Participation

The most crucial issue in this research is about the willingness to pay (WTP) of society as respondents. Respondents were asked to choose the rate / price of tree seedlings which are pollutants absorbent according to their ability. The most percentage (amount) of society's willingness-to-pay is the choice IDR.1.000 <WTP≤ IDR.5.000, the lowest percentage of society's willingness-to-pay is WTP > IDR.30.000. Society's average of maximum willingness to pay is as much IDR.9.068.63, with minimum WTP is as much IDR.2.000,- and maximum WTP is as much IDR.25.000,-. Society's average WTP is lower than price decided by tree breeders that is IDR.78.000,-. Society's willingness-to-pay for a smaller trees is lowers than decided price, thus it is hard to describe the true WTP value.

The low value of WTP showed that society's awareness to overcome the air pollution is low. This is because Tarakan government often spreads ready-to-plant trees periodically, beside the society prefers to plant some artificial plants than trees.

3.2 Analysis Of The Influence Variable

Results of regression analysis of the WTP value and variables that influence the WTP value is shown by the regression equation as follows:

$$LogWtp = 0.8012 - 0.1079Stat - 0.0156Veg + 0.2194LogUmur + 0.1759LogLuas - 0.0103LogPend + 0.0091LogPendp + 0.0593LogKes + 0.0618LogPemb + 0.6003LogPerwt \quad (1)$$

1. When house ownership status (Stat), type of vegetation (Veg), age, park width of the house (Luas), education level (Pend), income (Pendp), health cost (Kes), tree seeds purchase cost (Pemb), and constant tree maintenance cost (Perwt), thus the change of WTP is 0.8012 percent;
2. If the change of house ownership status increased 1 percent, the change of WTP will decrease 0.1079 percent, ceteris paribus;
3. If the change of the type of vegetation (Veg) increased 1 percent, the change of WTP will decrease 0.0156 percent;
4. If the change of age increased 1 percent, the change of WTP will increase 0.2194 percent, ceteris paribus;
5. If the change of park width (Luas) increased 1 percent, the change of WTP will increase 0.1759 percent, ceteris paribus;
6. If the change of education level (Pend) increased 1 percent, the change of WTP will decrease 0.0103 percent, ceteris paribus;
7. If the change of income (Pendp) increased 1 percent, the change of WTP will increase 0.0091 percent, ceteris paribus;
8. If the change of health cost (Kes) increased 1 percent, the change of WTP will increase 0.0593 percent, ceteris paribus;
9. If the change of tree seeds purchase cost (Pemb) increased 1 percent, the change of WTP will increase 0.0618 percent, ceteris paribus;
10. If the change of tree maintenance cost (Perwt) increased 1 percent, the change of WTP will increase 0.6003 percent, ceteris paribus;
11. The result of regression shows that only maintenance cost variable significantly influences WTP. Thus this shows that society's willingness to plant trees as the effort to improve air quality is not directly influenced or related to house ownership status, type of vegetation, age, park width, education level, income level, health cost, trees purchase cost. This is because society prefer to choose artificial trees than shady trees, it can be said that society does not pay more attention to shady trees.
12. The amount of coefficient of determination (R^2) obtained is amounted to 0.485600, this shows that the variation of the independent variables used in this research can explain the variation of the WTP variable as much 48.6%, while the remaining (51.4%) is explained by other variables which not incorporated into this research model, because these variables cannot be cashed.
13. This model passed the classical assumption test

4. Conclusions

1) Society's Average of maximum willingness to pay is as much IDR.9.068.63, with minimum WTP is as much IDR.2.000,- and maximum WTP is as much IDR.25.000.
2) The amount of society's WTP is influenced positively and significantly by maintenance cost.
3) The low of WTP value shows that society's awareness to overcome air pollution is low. This is because Tarakan government often spreads ready-to-plant trees periodically. Thus the society's WTP is not related to the society's awareness of environment.
4) As the facilitator, government must initiate society to create a custom of planting and aware of environmental preservation. In addition, socialization of trees, which have big contribution in absorbing air pollution, must be informed but still paying attention to the aesthetic value.
5) The reforestation is expected can be one of the alternatives to organize and to maintain the living environmental preservation. Development of environmental knowledge is the basic factor to create beautiful and pleasant environment especially in improving society's health and status.

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